

NOTES ON THE BIOLOGY OF *AMPHIBOLURUS CRISTATUS* AND *AMPHIBOLURUS SCUTULATUS*

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Amphibolurus cristatus and *Amphibolurus scutulatus* are large, long-legged, terrestrial agamid lizards, obviously rather closely related. They are conspicuous animals, but have not received much attention from naturalists. Although my information on them is somewhat scanty, it is presented here in the hope of encouraging other workers to make more penetrating observations on these interesting lizards.

Gray (1845) described *Grammatophora cristata*, which was later assigned to *Amphibolurus cristatus* by Boulenger (1885). Boulenger's plate of *A. cristatus* was reproduced by Waite (1929). There are a pair of prominent nuchal ridges on each side of the neck of *A. cristatus*, and the adults are quite colourful (Fig. 1).



Fig. 1.—Subadult male *Amphibolurus cristatus* photographed near Zanthus, W.A. The head and foreparts of the body are reddish-brown, fading to a creamy white colour posteriorly. The tail is prominent, banded with black and a creamy white. Breeding adults acquire a coloration involving a mixture of reds and yellows. The stance shown, with the forelegs extended and the foreparts raised, is characteristic of both species and presumably maximizes the lizard's field of view. These animals forage by sitting-and-waiting in the open spaces between plants and in the leaf litter under large shrubs and trees.

Stirling and Zietz (1893) described and figured *A. scutulatus*, from a series of specimens collected between Fraser Range and Queen Victoria Spring, W.A. These authors noted the sexual dimorphism, both in size and colour, of *A. scutulatus*.

Figure 2 illustrates the geographic distributions of the two species, which are sympatric in the eastern Goldfields. All localities I have are listed below, using the following abbreviations: AM (Australian Museum), SAM (South Australian Museum), WAM (Western Australian Museum), and ERP (my collection, now deposited with the Los Angeles County Museum of Natural History). Literature records are listed with the appropriate reference. Records requiring confirmation are not plotted but are listed in quotation marks.

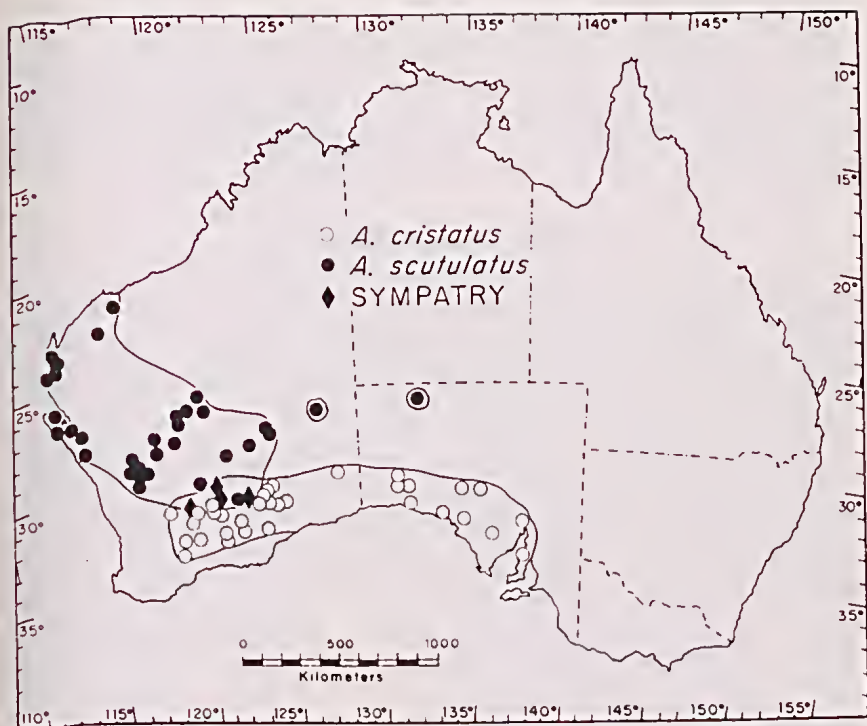


Fig. 2.—The geographic distributions of *Amphibolurus cristatus* and *A. scutulatus*. Symbols show the approximate positions of localities of collection; lines indicate probable limits of the geographic range. They occur in sympatry on at least four localities in the goldfields.

Amphibolurus cristatus

SOUTH AUSTRALIA: SAM R5534 (Tallaringa Well); SAM R3027 (Koonibba); SAM R3211 (Ooldea Soak); AM R7665, SAM R676 (Ooldea); AM R7661 (407 miles, E-W Line); SAM R693 (408 miles, E-W RR Line); SAM R8397 (SW Corner, Hambidge Reserve); SAM-no number (Yalata St, Fowlers Bay); SAM R3029 (Port Augusta Sandhills), SAM R2142 (Wirrulla, W. Coast); SAM R3655 (Mount Damper, Eyre Peninsula); SAM R1009 (Tareoola); SAM R3025 (Tiehera); SAM R3026 (Kingoonya); SAM R1586 (Buckleboo, via Kimba); SAM R3077 (Sandy localities throughout Gawler Ranges); SAM R2571 (Tickera, N. Yorke Peninsula).

WESTERN AUSTRALIA: AM R13693, SAM R4787 (Kalgoorlie); AM R8380 ("near Perth"); AM R3082 (Boulder); SAM R3030 (Bundah Plateau); SAM R3028 (between Fraser Range and Victoria Springs); WAM R19063 (Queen Victoria Spring); WAM R17341 (34 mi. NE Fraser Range HS); WAM R19055-57 (Norseman); WAM R19058 (21 mi. S. Norseman); WAM R19054 (Moir Rock, 40 mi. S. Norseman); WAM R17862 (30 mi. S. Coolgardie); WAM R24035 (Goongarrie); WAM R17864 (Coolgardie); WAM R19059, R21678 (Cundeelee); WAM R13463 (40 mi.; NW. Cundeelee); WAM R21665 (5 mi. NW. Cundeelee); WAM R26517-18 (Zanthus); ERP10272 (7 mi. W. Zanthus); ERP 10274 (8 mi. E. Zanthus); ERP 10278 (15 mi. E. Zanthus, or 24 mi. W. Kitchener); ERP 10279 (8 mi. W. Kitchener); WAM R19061 (Naretha); WAM R28274-75 (Kuender Siding, Lake Grace); WAM R23323 (Lake Cronin); WAM R24873 (Nevoria); WAM R15831 (2 mi. E. of Ghooli); WAM R19093 (Golden Ridge); WAM R19062 (Boorabbee, between Lake E11 and Forrest Lakes); WAM R25345

(Burbidge, 6 mi. S. Marvel Lock); WAM R19060 (Newman Rock, 88 mi. E. Norseman); WAM R28898 (8 mi. SW. Koolyanobbing); WAM R17465 (4 mi. S. Balladonia Hotel); WAM R19642 (Holt Rock District); WAM R19037-38 (Nungarin, 30 mi. NNW. Merredin); WAM R14122 (Dedari); WAM R22825 (3 mi. W. Widgimooltha); WAM R29969 (King Rocks Tennis Club, E. Hyden); ERP 13694 (28 mi. W. Balladonia); Glauert, 1961 (Fitzgerald Peaks, "Learmonth," and "Bernier Island"); Ride *et al.*, 1962 ("Bernier Island").

Amphibolurus scutulatus

WESTERN AUSTRALIA: AM R2959 ("Perth"); AM R3081, R3178 (Boulder); AM R4060 (Kalgoorlie); AM R11376 (Lake Violet, via Wiluna); ERP-81 specimens (16 mi. S. Atley HS); ERP 13018 (Lake Yeo HS); WAM R19078-79 (7 mi. W. Mooka); WAM R19089 (10 mi. N. Hines Hill); ERP 13465 (8 mi. N. Wiluna); WAM R13706 (Mt. Fisher); WAM R19084-85 (20 mi. W. Sandstone); ERP 10045 (9 mi. E. Millrose HS); ERP 10003 (74 mi. NE. Paynes Find, 28°45'; 118°32'); ERP 10170-71 (7 mi. W. of Millrose HS); ERP 10767 (about 60 mi. ENE. Laverton, 28°22'; 123°21'); WAM R13128 (Duck Creek, Wyloo); WAM R19090 (7 mi. S. Yellowdine); WAM R469 (Waddouring); WAM R12036 (Lindenbury?); WAM R21865-58, R24785 (Caron); WAM R19091 (2 mi. N. Comet Vale); WAM R24869-71 (11 mi. E. Wialki); WAM R15711 (Yeo Chasm); WAM R19080-82 (9 mi. W. Doorawarrah); WAM R20207 (Big Hill Pool, Mt. Herbert); WAM R12911 (Widgimooltha); WAM R19070-77 (25 mi. S. Warroora); WAM R24031-34 (Goongarrie); WAM R26427 (8 mi. W. Tamala, Shark Bay turnoff); WAM R27717 (10 mi. NE. Kurara); WAM R27718 (12 mi. E. Rothsay); Loveridge 1934 (Wiluna; Lake Violet); Stirling and Zietz, 1893 (between Fraser Range and Queen Victoria Spring); Fry, 1914 (Kalgoorlie; Mt. Malcolm).

SOUTH AUSTRALIA: Loveridge, 1938 (Officer Creek)

Amphibolurus scutulatus is a denizen of habitats dominated by various species of *Acacia* and chenopodeaceous shrubbery; in 16 months of field work we never observed it in sandplain and sandridge habitats with *Triodia* grasses. I was able to make only very limited observations on *A. cristatus*, most of them along the western portion of the trans-line in open mallee-eucalypt habitats. I collected one juvenile *A. cristatus* further south in a rocky chenopodeaceous shrub area along the western part of the Eyre highway (ERP 13694). Both species forage in the open spaces between plants and in leaf litter under various shrubs, especially *Acacia*. Table 1 summarises the micro-habitat locations of 67 undisturbed *A. scutulatus* when first sighted.

Tables 2 and 3 summarise the stomach contents of 88 *A. scutulatus* and 5 *A. cristatus*. Although my sample size for *A. cristatus* is rather small, there are suggestions of a difference in diet, with *A. cristatus* taking more grasshoppers and no termites. The diet of *A. cristatus* is similar to that of the North American iguanid lizard *Callisaurus draconoides* (Pianka, 1965), which is probably its "ecological equivalent" in the new world.

Figure 3 shows the highly significant correlation ($r=.583$, $P < .001$, $N=81$) between the body temperature of undisturbed *A. scutulatus* ($\bar{x}=38.9$, $s=1.87$, $N=81$) and the ambient air temperature at about a meter above the ground ($\bar{x}=31.9$, $s=4.17$, $N=87$). It is noteworthy that at higher air temperatures the lizards tend to be in the shade, whereas at lower air temperatures they are usually in the sun (Figure 3).

One adult female *A. cristatus*, measuring 95 mm in snout-vent length, was collected on 11 January 1967; this specimen contains five 20 mm long eggs in her oviducts. Adult female *A. scutulatus* with enlarged eggs are tabulated in Table 4. Eggs are probably laid in February. Hatchling *A. scutulatus* measure about 32 mm in snout-vent length.

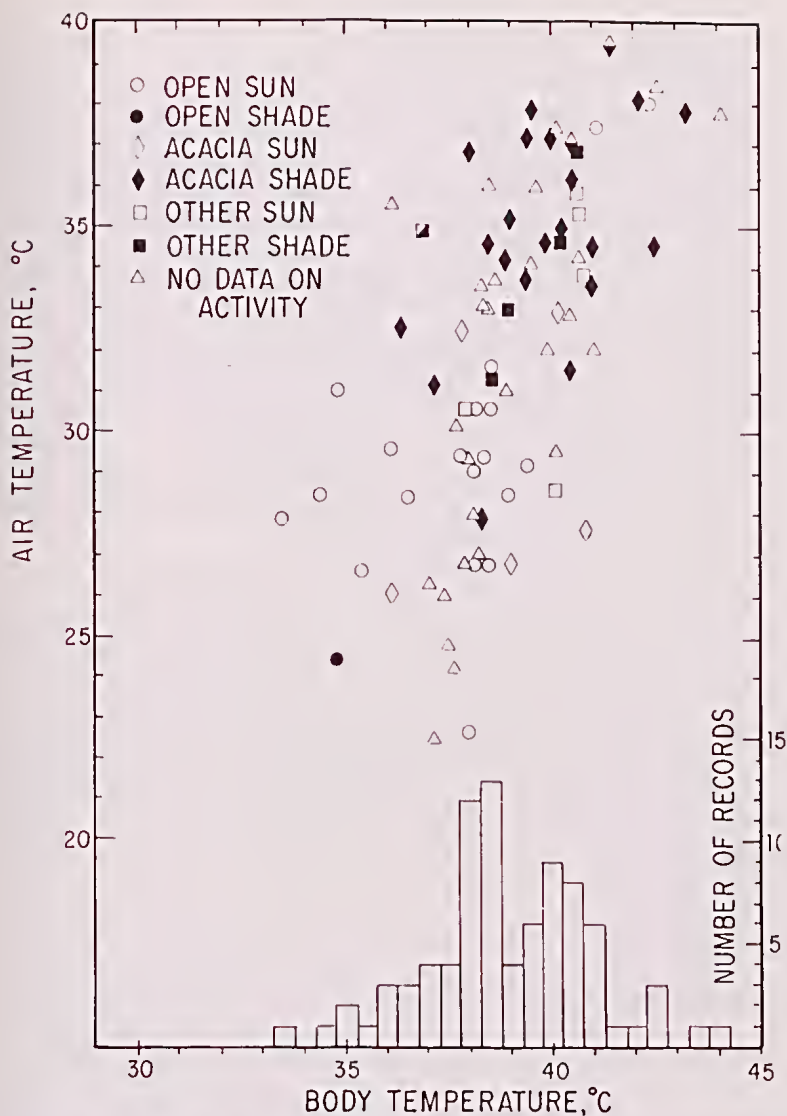


Fig. 3.—Plot of ambient air temperature (1 meter above ground) against the body temperatures of undisturbed, but active, *Amphibolurus scutulatus*, showing the microhabitat locations of the lizards. The frequency distribution of active body temperatures is given at the bottom of the graph. See text for statistics.

ACKNOWLEDGEMENTS

Museum curators H. G. Cogger, F. J. Mitchell, and G. M. Storr allowed me access to the collections under their care. My wife, Helen, observed and collected many of the specimens and provided companionship in the field. This study was part of a project supported by grants from the U.S. National Institutes of Health and the National Science Foundation.

REFERENCES

- BOULENGER, G. A., 1885. *Catalogue of the lizards in the British Museum (Natural History)*, 1. 2nd Ed.; London.
- FRY, D. B., 1914. On a collection of reptiles and batrachians from Western Australia. *Records of the Western Australian Museum*, 1: 174-210.
- GLAUERT, L., 1961. *A Handbook of the lizards of Western Australia*, Handbook No. 6 Western Australian Naturalists' Club; Perth.
- GRAY, J. E., 1845. *Catalogue of the specimens of lizards in the collection of the British Museum*. British Museum; London.
- LOVERIDGE, A. 1934. Australian reptiles in the Museum of Comparative Zoology, Cambridge, Massachusetts. *Bull. Mus. Comp. Zool.*, 77: 243-383.
- LOVERIDGE, A., 1938. On some reptiles and amphibians from the central region of Australia. *Trans. Roy. Soc. South Australia*, 62: 183-191.
- PIANKA, E. R., 1965. Species diversity and ecology of flat land desert lizards in western North America. Ph.D. Thesis, Univ. of Washington, Seattle, Wash. (212 pp.).
- RIDE, W. D. L., G. F. MEES, A. M. DOUGLAS, R. D. ROYCE, and C. H. TYNDALE-BISCOE, 1962. Bernier and Dorre Islands. *Fauna Bulletin* 2, Fisheries Department; Perth.
- STIRLING, E. C. and A. ZIETZ, 1893. Vertebrata. *Trans. Roy. Soc. South Australia*, 16: 154-176.
- WAITE, E. R., 1929. *The Reptiles and Amphibians of South Australia*. Handbooks of the Flora and Fauna of South Australia. British Science Guild. Government Printer; Adelaide (270 pp.).

TABLE 1. MICROHABITAT LOCATIONS OF 87 UNDISTURBED *AMPHIBOLURUS SCUTULATUS* WHEN FIRST SIGHTED. (HALF LIZARDS ARE SPLIT BETWEEN TWO CATEGORIES.)

Microhabitat Position	Number of Lizards	Percentage of Total
Open sun between plants	24	35.8
Open shade	1	1.5
Acacia in sun	8.5	12.7
Acacia in shade	20.5	30.6
Sun of various shrubs	1	1.5
Shade of various shrubs	2	3.0
Eucalyptus in sun	3.5	5.2
Eucalyptus in shade	3.5	5.2
Other in sun	2	3.0
Other in shade	1	1.5
TOTALS	67	100.0

TABLE 2. SUMMARY OF THE STOMACH CONTENTS OF 88 SPECIMENS OF *A. SCUTULATUS*. VOLUMES MEASURED IN CUBIC CENTIMETRES.

Prey Item	Number	Volume	% of Total Volume	Frequency
Centipedes	24	2.67	4.90	25.0
Spiders	17	2.89	5.51	19.3
Scorpions	2	.10	.19	2.3
Ants	1,859	14.45	27.55	98.6
Becs and Wasps	43	2.03	3.87	29.6
Grasshoppers	26	3.33	8.35	27.3
Roaches	3	.30	.57	1.1
Stick Insects	1	.09	.17	1.1
Beetles	56	1.79	3.41	31.8
Termites	1,484	12.34	23.53	32.9
Bugs (Homoptera and Hemiptera)	15	.77	1.47	13.7
Flies (Diptera)	7	.44	.84	5.7
Moths and Butterflies (Lepidoptera)	1	.11	.21	1.1
All insect larvae	38	2.85	5.43	10.2
Unidentified Insects	21	1.49	2.84	23.9
Lizards* and bones	4	.18	.34	3.4
Plant materials	17	.95	1.81	19.3
Debris and sand		4.15	7.91	79.5
Nematodes	369	1.43	2.73	54.5
TOTALS	3,987	52.38	99.63	

* *Ablepharus greyi*.

TABLE 3. SUMMARY OF THE STOMACH CONTENTS OF 5 SPECIMENS OF *A. CRISTATUS*. VOLUMES MEASURED IN CUBIC CENTIMETRES.

Prey Item	Number	Volume	% of Total Volume	Frequency
Ants	21	0.53	16.2	80
Wasps and Bees	2	0.09	2.8	20
Grasshoppers	4	1.57	48.0	80
Beetles	1	0.20	6.1	20
Bugs (Hemiptera)	1	0.03	0.9	20
Unidentified Insects	4	0.27	8.3	80
Lizards (<i>Ablepharus greyi</i>)	1	0.10	3.1	20
Floral plant materials	2	0.30	9.1	40
Vegetative plant materials	3	0.12	3.7	60
Debris, including sand		0.05	1.5	40
Nematodes	5	0.01	0.3	20
TOTALS	44	3.27	100.0	

TABLE 4. DATA ON REPRODUCTIVE STATUS OF SEVEN GRAVID FEMALE *A. SCUTULATUS*. EGG DIAMETERS AND SNOOT-VENT LENGTHS IN MILLIMETRES.

Specimen	Date of Collection	Clutch Size	Egg Diameter	Snout-Vent Length
ERP 10019	28 November 1966	5	Ovarian 4	102
ERP 10526	31 January 1967	7	Ovarian 8	98
ERP 10543	1 February 1967	8	Oviducal 17	96
ERP 13260	30 December 1967	10	Ovarian 4	100
ERP 13265	30 December 1967	5	Oviducal 16	93
ERP 13640	9 January 1968	6	Ovarian 8	95
Loveridge, 1938	January 1934	5	Oviducal 20	105

FIELD NOTES ON BIRDS BY THOMAS CARTER

Communicated by GILBERT P. WHITLEY, Australian Museum, Sydney

My old friend the veteran ornithologist, Tom Iredale, now in his 92nd. year, recently gave me some manuscripts among which were four pages of writing-pad paper bearing notes on Western Australian birds written by Thomas Carter in 1922. Some of the data in these notes were included in papers published by Carter in the *Ibis* and the *Emu*, but their full publication now will not be without value as a record of ornithological conditions half a century ago in habitats now radically altered. It has been thought best to retain Carter's wording and spelling of names as he gave them. Most of the scientific names are readily identifiable by present-day ornithologists but in any case can be interpreted from the R.A.O.U. and other current checklists.

Thomas Carter's life and writings are detailed in H. M. Whittell's *The Literature of Australian Birds*, 1954, pp. 119-121 and epitomised in Serventy and Whittell's *Birds of Western Australia*, 1948, pp. 36-37. A modern biography of Carter, by Freda Vines, including hitherto unknown information obtained from his son Christopher (born in Western Australia but now living in Worcester, England), has been published in the *Journal and Proceedings of the Royal Western Australian Historical Society*, 6 (7), 1968, pp. 7-21.

NOTES FROM SOUTH WEST AND MID-WEST AUSTRALIA, 1922
January 3rd. Many recently fledged young of *Meliornis longirostris* and *Glycyphila fulvifrons* seen near Busselton.

January 24th. Saw a recently fledged *Gymnorhina dorsalis*, Busselton.

January 28th. Saw a recently fledged *Cracticus torquatus*, Busselton.

The adult ♂ flew straight at my face to within about three feet, screaming loudly at me.

February 5th. Saw a family party of *Malurus splendens* feeding on small insects, on a high road just outside Busselton township, half an hour after sundown (getting dark). This bird is much scarcer about Busselton and S. West generally, than in former years. Many people remarked this to me. I imagine it is result of too many cats.

February. Crows were numerous in the Broome Hill district, where, in former years it was a very rare thing to see any. Many farmers com-